

PATENT SPECIFICATION

(11) 1321709

1321709

DRAWINGS ATTACHED

(21) Application No. 52065/70 (22) Filed 2 Nov. 1970
(31) Convention Application No. 873354 (32) Filed 3 Nov. 1969 in
(33) United States of America (US)
(44) Complete Specification published 27 June 1973
(51) International Classification C08F 1/98//B01F 7/24 15/02
(52) Index at acceptance

C3P 13D2A 13D2B 13D2C 13D2X 13D8A 13D8B 13G4B
13G6 13G7C 13G7Y 13H1 13H2A 13K2A 13K3B
13N1 13N2 13R2A 13T1Y 13Y
B1C 1 10 14 19F4D 19H 25 5 6
B1X 20 3X6

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(54) POLYMERISATION PROCESS

(71) We, E. I. DU PONT DE NEMOURS AND COMPANY, a corporation organized and existing under the Laws of the State of Delaware, located at 5 Wilmington, State of Delaware, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by 10 which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a polymerisation process, and more particularly concerns an 15 improved "slurry" polymerisation process.

The cost of manufacturing elastomers in 20 a solution polymerization process is greatly influenced by the cost of isolating the elastomer from the solvent, solvent recovery equipment and the cost of the solvent used. In addition, practical handling methods dictate that the solution viscosity of the reaction mass be low which in turn limits the polymer concentration obtainable. The unreacted monomers when separated from the polymer 25 during recovery are desirably recycled to the reactor to make the process economical.

It is known that elastomeric polymers can 30 be prepared in a "slurry" process by copolymerizing monomers in a nonsolvent for the polymer such as a halogenated hydrocarbon solvent as disclosed in USP 3,291,780 or by copolymerizing the monomers in one or more of the liquid monomers themselves as disclosed in USP 3,370,052 and 3,358,055.

A "slurry" process, particularly one using a 35 liquid monomer reaction medium, has the advantages of requiring a smaller reactor volume throughput per unit of polymer produced than a solution process and a higher reaction rate per unit amount of catalyst. These advantages permit the use of a smaller 40 reactor per unit of polymer produced and

mass transfer problems and mixing are minimized because of the lower viscosity of the reaction medium compared to the solution process. In addition, the absence of a solvent eliminates the need for solvent isolation and recycle equipment minimizing the cost for equipment needed for polymer isolation and purification.

Although "slurry" polymerization has 45 many advantages, it does have certain disadvantages. For example, the elastomeric copolymer thus prepared tends to stick to interior reactor walls and surfaces in contact with the reaction medium, thereby fouling the reactor and eventually plugging the connecting lines. Also, the polymer produced usually contains occluded portions of the polymerization medium.

There is a need for a process for carrying 50 out a "slurry" polymerization process for elastomers whereby the elastomer can be removed from the reactor without causing reactor fouling, and the polymer produced is practically free of occluded polymerization medium.

We have now developed a "slurry" polymerization process that can be carried out 55 on a continuous basis without substantial fouling of the reactor and which results in a polymer practically free of occluded polymerization medium.

According to the invention there is provided 60 a process for preparing a polymer in a reactor in the presence of a catalyst in a liquid organic polymerization medium wherein the polymer is insoluble in the polymerization medium, and forms agglomerates on interior reactor surfaces, which includes the steps of simultaneously and continuously 65 (a) scraping agglomerated polymer from interior reactor surfaces, (b) collecting the

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scraped polymer thus removed, and (c) concurrently shearing and extruding the collected agglomerated polymer whereby occluded polymerisation medium is separated from the polymer and remains in the reaction vessel and the polymer is discharged from the reaction vessel.

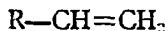
The process of the invention may be performed in any suitable apparatus. However, 10 two embodiments of apparatus suitable for the performance of this invention are illustrated by way of example in the accompanying drawings. In these drawings:

Fig. 1 is a preferred embodiment showing schematically a preferred flow pattern of the process of the invention. The reactor houses an open-cage, double-flighted, helical ribbon to scrape agglomerated polymer from the walls of the reactor in combination with 15 an extruder in the reactor to express occluded polymerization medium from the polymer while removing polymer from the reactor. Apparatus of this type is disclosed and claimed in our copending Application 52066/70 20 (Serial No. 1,321,710).

Fig. 2 is an alternative embodiment of the reactor showing two spiral helices intermeshed and converging on an extruder thereby adapted to scrape agglomerated polymer 30 from the interior walls of the reactor and then deliver it to the extruder which shears and extrudes it, thus removing occluded polymerization medium from the polymer while extruding the liquid-free polymer from the 35 reactor.

The polymerization process of this invention is useful in preparing polymers wherein the polymer is a separate phase insoluble in the polymerization medium and adheres to and 40 agglomerates on the interior reactor surfaces exposed to the polymer. The polymer can be a homopolymer or a copolymer made by interpolymerizing two or more different monomers.

Polymers that can be prepared according 45 to this invention include those obtained by copolymerizing ethylene with another α -monoolefin having the structure

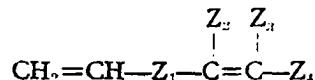


wherein R is hydrogen or C_1-C_{16} alkyl, preferably straight-chained. Representative α -monolefins are propylene, 1-butene, 1-pentene, 50 1-hexene, 1-heptene, 1-octene, 1-octadecene, 6-ethyl-1-decene and 5-methyl-1-hexene.

Other polymers include sulfur curable α -olefin elastomers copolymers. By "sulfur curable" it is meant that the copolymer will 55 contain at least 0.1 gram moles of ethylenic carbon-to-carbon double bonds per kilogram. These include the normally solid copolymers of ethylene and at least one nonconjugated diene having only one polymerizable double bond. In order to obtain a copolymer with desirable elastomeric properties, it should

contain between about 20 to 80 weight per cent ethylene units and 80 to 20 weight per cent of one or more other α -olefin units.

Useful sulfur curable copolymers include terpolymers of ethylene, another α -monolefin and a nonconjugated diene having only one polymerizable double bond. Useful α -monolefins are described above. Particularly preferred are copolymers of ethylene, propylene and a nonconjugated diene (called EPDM polymers) because of their outstanding physical properties. The diene can be an open chain or cyclic compound but must have at least one polymerizable double bond in the sense that at least one double bond of the diene reacts to a substantial degree in forming the polymer backbone. The open chain dienes have the general formula:



wherein Z_1 is C_1-C_8 alkylene and Z_2 , Z_3 and Z_4 are independently hydrogen or alkyl radicals and the Z groups are selected such that the diene has from about 6-22 carbon atoms and only one terminal double bond.

Useful open chain dienes include 1,4-hexadiene; 1,9-octadecadiene; 6-methyl-1,5-heptadiene and 15-ethyl-1,15-heptadecadiene.

Useful cyclic nonconjugated dienes include dicyclopentadiene; 5 - alkylidene - 2 - norbornene, e.g. - 5 - ethylidene - 2 - norbornene; 5 - alkenyl - substituted 2 - norbornenes, e.g. 5 - (2' - butenyl) - 2 - norbornene; 2 - alkyl - 2,5 - norbornadienes, e.g. 2 - ethyl-2,5 - norbornadiene and 1,5 - cyclooctadiene.

A preferred EPDM copolymer is ethylene/propylene/1,4 - hexadiene.

Representative copolymers made from the above-described α -monolefins that can be made by the process of this invention are given in U.S. Patents 2,933,480; 3,000,866; 3,063,973; 3,093,620; 3,093,621; 3,151,173; and 3,260,708.

The polymer is conveniently formed by carrying out the polymerization in the liquid monomers to be polymerized. Since the liquid part of the medium can contain liquids other than the liquid monomers, it will be referred to, for convenience, as "liquid organic polymerization medium". The catalyst used can be a conventionally known catalyst. Ziegler-type catalysts have been found useful.

The polymer forms as a separate phase containing occluded liquid organic polymerization media and is swollen with dissolved media. When the polymer phase is formed it adheres to the equipment surfaces exposed to the polymer, coalesces and forms an agglomerated mass. The agglomerated polymer, is scraped from the equipment surfaces, collected by pumping it to a common location in the reactor and extruded from the reactor.

5 The occluded portion is removed or expressed by the mechanical action of kneading or shearing the polymer while still in the reactor and extruder. This is accomplished when the polymer is scraped and extruded. The dissolved portion can be vaporized from the polymer as the polymer leaves the reactor or is removed by other conventional means at some later time.

10 An apparatus for carrying out the process of this invention is described below and is illustrated in the drawings.

15 Referring to Fig. 1, the apparatus consists essentially of a generally cylindrical, vertically aligned vessel 1, with a circular cross section having a polymerization section 2 and a polymer collecting section 3 in communication with each other. Polymerization section 2 is made of a cylindrical section 4 and a truncated cone section 5 and houses an open-cage, double-flighted spiral ribbon 6. The polymer collecting section houses an extruder 7. Alternatively, reactor 1 can be horizontally aligned or canted and the spiral ribbon can be single or multiple flighted.

20 The spiral ribbon is rotatably mounted and has an outside diameter slightly smaller than the inside diameter of vessel 1 so that it almost scrapes the walls of the polymerization region 2 as it rotates. It is desirable to maintain a sufficient clearance between the spiral ribbon 6 and vessel 1 to avoid mechanically binding the spiral ribbon. The amount of clearance A can vary according to the

25 type of polymer being prepared and the amount of polymer build-up permissible for continuous operation. In preparing an ethylene/propylene/1,4 - hexadiene (58/36/6) polymer in a reactor having an inside diameter of 8.9 cm. the spiral ribbon desirably has a clearance of about .32 cm. from the inside wall of vessel 1. The pitch B of the spiral ribbon can be from 1/2 to 3 ribbon diameters and preferably is 3/4 to 1-1/2 diameters for optimum effectiveness. The pitch B is the longitudinal spacing of corresponding points on adjacent flights and in the case of multiple flights, the pitch is equal to the longitudinal spacing multiplied by the number of flights. The dimension of the spiral ribbon in the radial direction C should be no greater than 1/4 of the largest inside diameter of vessel 1. The lower end of the spiral ribbon conforms to the conical section of the polymerization chamber.

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60 In operation, spiral ribbon 6 simultaneously removes any material adhering to the walls of vessel 1 and moves it to extruder 7 which for practical reasons generally has a maximum diameter of less than 1/2 that of vessel 1, and a flight pitch of about 1/2 to 2 extruder diameters. The extruder must be so designed as to maintain a seal of polymer which prevents monomers flowing out of the reactor.

65 The spiral ribbon and extruder can be joined to rotate at the same speed or arranged so that they rotate at different speeds.

70 A stationary rod 9 is placed inside the cage of the spiral ribbon and is positioned to remove polymer from the inside periphery of the spiral ribbon. It is desirable to maintain a clearance between rod 9 and the spiral ribbon 6 to avoid mechanically binding the moving parts. A clearance of up to about 4% of the diameter of vessel 1 has been found useful.

75 Rod 9 is attached at one end to the inside wall of vessel 1 at point 10 and at the other end can be free or, if desired, attached to the extruder at point 11 by a bearing (not shown) which permits the extruder to rotate but holds the rod stationary.

80 Rod 9 can have a cross section of any desired configuration, e.g. rectangular, square, elliptical, triangular or circular and any one particular cross section can be used with varying thicknesses along the length of the rod for added strength. If during use, material build-up on the rod becomes excessive, the portion of the rod in the conical section can be eliminated or the monomer mixing region and the polymer collecting region can be made having the same size cross section, thereby eliminating the truncated conical section and the rod can be rotated on its axis.

85 An alternative reactor which can be used to carry out the process of this invention is shown in Fig. 2. It comprises a reactor 28 having a polymerization region 29 in the shape of double intersecting cones and a polymer collecting region 30, two spiral ribbons 31 and 32 positioned side by side and intermeshed so that they scrape the inside surface of each other and the walls of the polymerization chamber as they rotate, and an extruder 33 in the polymer collecting chamber.

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95 This invention provides the advantage of being able to carry out a continuous "slurry" process without fouling the reactor, resulting in the production of polymer free for all practical purposes from residual liquids and monomers.

100 The process of this invention is illustrated by the following examples. All parts, percentages and proportions are by weight unless otherwise indicated. Pressures are gauge pressures.

105 The apparatus used to carry out this example is shown in Fig. 1. Cylindrical portion 4 of reactor 1 has an inside diameter of 8.89 cm. and a length of 27.9 cm. Truncated conical section 5 which serves as a transition between the cylindrical portion 4 and the polymer collecting section 3 is 3.81 cm. in height with a diameter of 8.89 cm. at one end to match the connecting portion of the polymer collecting section 3.

110 The spiral ribbon contained within the

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polymerization section 2 has an outside diameter of 8.25 cm. in the cylindrical section of the polymerization region and spirals in the conical section maintaining a clearance of .32 cm. It is double-flighted having a pitch of 17.8 cm. Within the spiral ribbon is stationary rod 9 made of steel and positioned to scrape the inside portion of the spiral ribbon as the ribbon rotates. The polymer collecting region is 41.61 cm. long housing an extruder with a varying diameter, pitch and flight depth. The extruder is made up of four sections. Details of the sections are not shown. The first section is cylindrical having an outside diameter of 3.81 cm. to match the small diameter of the truncated conical section and a length of 12.4 cm. with flights of 1.11 cm. deep pitched at 3.2 cm. The second section is a transitional section having an outside diameter of 3.81 cm. to match the first section then tapering to a diameter of 2.54 cm. This transitional section has a length of 6.35 cm. with a flight depth ranging from 1.11 cm. to .95 cm. and a pitch varying from 3.2 cm. to 2.54 cm., respectively. The third section is cylindrical having an outside diameter of 2.54 cm. and a length of 10.98 cm. The flight depth is .95 cm. with a pitch of 2.54 cm. The fourth section is 11.88 cm. long, having an outside diameter of 2.54 cm. and a flight depth of .38 cm. pitched at 2.54 cm. The transition in flight depth between the third and fourth sections is gradual.

The amount of liquid in reactor 1 is maintained at about 1.0 liter. The liquid level is measured with a gamma radiation source and detector (not shown) and manually controlled to maintain proper volume in the reactor. The extruder is used to pump the polymer to pressures in excess of 50 kg/cm² for discharge between 50 and 150 kg/cm² by pressure control valve 22. The spiral ribbon and extruder are operated at 20 rpm.

Reactor 1 is surrounded with a water jacket maintained at approximately 50°C. The liquid monomer temperature in reactor 1 is maintained at 45°C. The ingredients are fed to reactor 1 in the following manner: ethylene, propylene and hydrogen gases are fed to conduit 12 through flow meters (not shown) and directed to the inlet of compressor 16. The average flow rates are as follows: through port 13 passes ethylene at 88.5 grams per hour; through port 14 passes propylene at 437 grams per hour; and through port 15 passes ethylene plus 1.73 volume per cent hydrogen at 68 grams per hour. These gases are then compressed in compressor 16 to a pressure of 35.1 kg/cm² and then condensed in water-cooled condenser 17 at a temperature of 25°C. and fed to the conical section of the reactor through pressure regulating valve 18. A third monomer and catalyst are added to the reactor as two liquid streams. One stream is fed to the reactor through port 20 as a 0.0171 mole per liter solution of vanadium tris(acetylacetone) in 1,4-hexadiene and another stream is fed through port 21 as a 0.639 mole per liter solution of diisobutylaluminum chloride in 1,4-hexadiene. These solutions are fed at a rate of 50 milliliters per hour and 23.5 milliliters per hour, respectively.

The polymer forms as a separate phase which adheres to the reactor and processing equipment and agglomerates into a mass. As the spiral ribbon turns, it scrapes the polymer from the sides of the reactor, and the stationary bar 9 scrapes the polymer from the inside surface of the spiral ribbon permitting the helix to pump the polymer to the polymer collecting section 3. The extruder 7 in the polymer collecting chamber shears the polymer as it pumps the polymer through pressure control valve 22 and out exit port 23. The occluded monomer is freed from the polymer during the shearing of the polymer by the helix and the extruder and it is not pumped from the reactor but instead migrates upwards against the direction of polymer travel to the monomer mixing section 2. Dissolved monomers in the polymer are vaporized as the polymer moves from the high pressure area in the extruder output through pressure control valve 22.

The polymerization process is evaporatively cooled. The heat of the reaction is removed by allowing the reaction liquid to boil. The vapor produced passes through temperature control valve 24 and into conduit 12 to be recycled with fresh monomers. As an additional aid to maintaining a proper temperature in reactor 1, the reactor is surrounded by a water jacket 25 having inlet port 26 and exit port 27.

The copolymerization process is continuous for a period of 29 hours with the production rate of copolymer of about 56 grams per hour. The reaction is maintained at a temperature of 45°C. with a pressure of about 21.1 kg/cm² in the vapor space of reactor 1. A typical analysis of the vapor in the reactor is 0.8% nitrogen, 0.2% hydrogen, 31% ethylene and 68% propylene. Excess monomers are removed from the reactor through a port (not shown) on the side of the reactor vessel to control the liquid level of the reactor so that the level of the liquid never exceeds the height of the spiral ribbon.

Analysis of the copolymer discharged from the extruder, but prior to flashing, shows that it contains approximately 0.40 gram of dissolved residual liquid monomers per gram of dry polymer produced. An independent test run under the reactor conditions of this example shows that the solubility of the liquid monomers in the polymer is 0.40 gram of monomers per gram of dry polymer. Therefore, the presence of 0.40 gram of residual

liquid monomers shows that all entrained or occluded monomers are expressed or removed from the polymer, in the reactor, before it is discharged from the extruder. The monomers 5 are flashed off and analysis shows that the copolymer average composition is 58.3 weight per cent ethylene, 36.2 weight per cent propylene and 5.41 weight per cent 1,4-hexadiene and the copolymer has a Wallace Plasticity of 45.

EXAMPLE 2

Example 2 is carried out according to the procedure of Example 1 except for the following changes: The monomer feed rate to reactor 1 is ethylene, 118 grams per hour through port 13; propylene, 407 grams per hour through port 14; and ethylene containing 5.38 volume per cent hydrogen, 3.2 grams per hour through port 15. These monomers 15 are fed to the compressor 16 and compressed to 35.1 kg/cm² and fed to condenser 17 where they are condensed at a temperature of 25°C. then passed through valve 18 and into the conical section of reactor 1. The third 20 monomer and catalyst are fed to reactor 1 in the following manner: port 20 carries 24.8 milliliters per hour of 1,4-hexadiene containing 0.00372 mole per liter of vanadium tris-acetylacetone and 0.0703 mole per liter of benzotrichloride and port 21 carries a stream 25 of 20 milliliters per hour of 1,4-hexadiene containing 0.191 mole per liter of triethyl aluminum and 0.0386 mole per liter of diethyl aluminum chloride. The copolymerization process 30 is continuously run for 49 hours at 45°C. with an average production rate of 66 grams per hour copolymer.

Analysis of the copolymer discharged from the extruder but prior to flashing, shows that 40 it contains approximately 0.40 gram of dissolved residual liquid monomers per gram of dry polymer produced. An independent test run under the reactor conditions of this example show that the solubility of the liquid monomers in the polymer is 0.40 gram of monomers per gram of dry polymer. Therefore, the presence of 0.40 gram of residual liquid monomers shows that all entrained or 45 monomers are expressed or removed from the polymer, in the reactor, before it is discharged from the extruder. The monomers are flashed off and analysis shows that the copolymer average composition is 55.9 weight per cent ethylene, 41 weight per cent propylene, and 3.1 weight per cent 1,4-hexadiene and the copolymer has a Wallace Plasticity of 32.

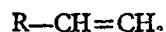
The process of this invention is of particular interest in relation to elastomers, but can 55 also be used to prepare plastomers especially above their crystalline melting point.

WHAT WE CLAIM IS:—

1. A process for preparing a polymer in

a reactor in the presence of a catalyst in a liquid organic polymerization medium wherein the polymer is insoluble in the polymerization medium, and forms agglomerates on interior reactor surfaces, which includes the steps of simultaneously and continuously (a) scraping agglomerated polymer from interior reactor surfaces, (b) collecting the scraped polymer thus removed, and (c) concurrently shearing and extruding the collected agglomerated polymer whereby occluded polymerisation medium is separated from the polymer and remains in the reaction vessel and the polymer is discharged from the reaction vessel.

2. A process as claimed in claim 1 wherein ethylene is copolymerized with another α -mono-olefin having the general formula



wherein R is a C_1-C_{16} alkyl group.

3. A process as claimed in claim 2 wherein said α -mono-olefin is selected from propylene, 1 - butene, 1 - pentene, 1 - hexene, 1 - heptene, 1 - octene, 1 - octadecene, 6 - ethyl-1 - decene and 5 - methyl - 1 - hexene.

4. A process as claimed in claim 2 or 3 wherein ethylene is copolymerized with another α -mono-olefin and a non-conjugated diene having only one polymerizable double bond.

5. A process as claimed in claim 4 wherein the product contains 20—80 weight % ethylene residues.

6. A process as claimed in claim 4 or 5 wherein said α -mono-olefin is propylene.

7. A process as claimed in claim 6 wherein ethylene is copolymerised with propylene and 1,4-hexadiene.

8. A process as claimed in claim 6 wherein ethylene is copolymerised with propylene and 5 - ethylidene - 2 - norbornene or dicyclopentadiene.

9. A process as claimed in any of the preceding claims wherein said liquid organic polymerisation medium is composed of one or more monomers for said process.

10. A process as claimed in any of claims 2—9 wherein the catalyst consists essentially of vanadium tris(acetylacetone) and diisobutylaluminum chloride.

11. A process as claimed in any of claims 2—9 wherein the catalyst consists essentially of vanadium tris(acetylacetone), benzotrichloride, triethyl aluminum and diethyl aluminum chloride.

12. A process as claimed in any of the preceding claims when carried out in a vessel defining a reaction chamber provided with at least one rotating open-cage helically flighted ribbon adapted to remove agglomerated polymer from an inner wall of said chamber.

13. A process as claimed in claim 12 wherein the product is extruded from the reactor vessel by a screw extruder of smaller maxi-

mum diameter than said open-cage helically flighted ribbon.

14. A process as claimed in any of the preceding claims wherein dissolved monomers are allowed to flash off from the polymer product on discharge from the reactor vessel.

5 15. A process as claimed in any of the preceding claims when carried out in apparatus substantially as shown in Figures 1 or 2 of the accompanying drawings.

10 16. A process as claimed in claim 1, substantially as hereinbefore described with reference to Examples 1 or 2.

17. A polymer whenever prepared by the process claimed in any of the preceding 15 claims.

18. An ethylene/propylene/1,4 - hexadiene copolymer whenever prepared by the process claimed in any of claims 1—16.

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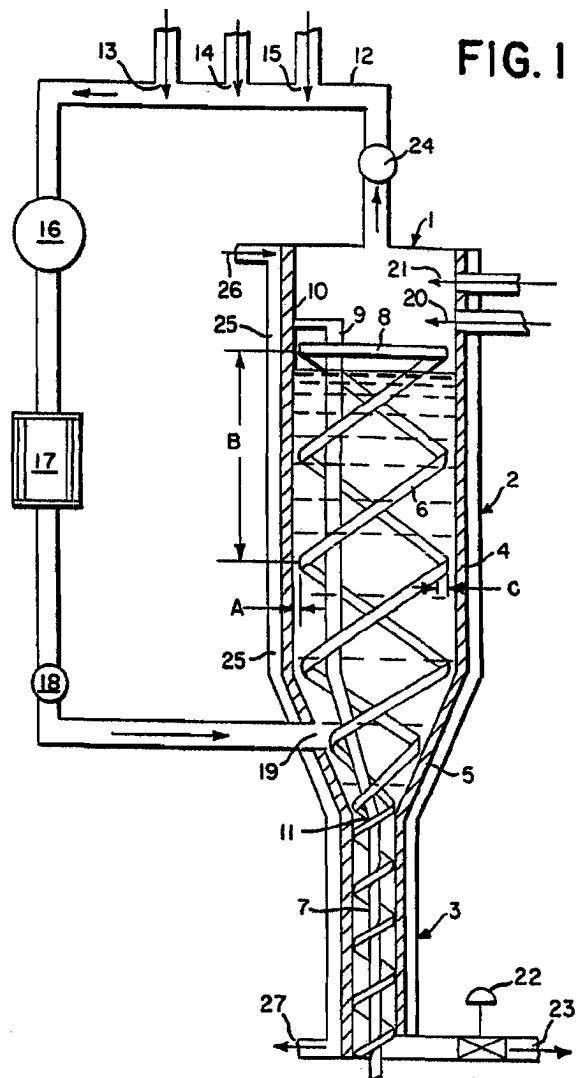
Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1973.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
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1321709

COMPLETE SPECIFICATION

2 SHEETS

*This drawing is a reproduction of
the Original on a reduced scale
Sheet 1*



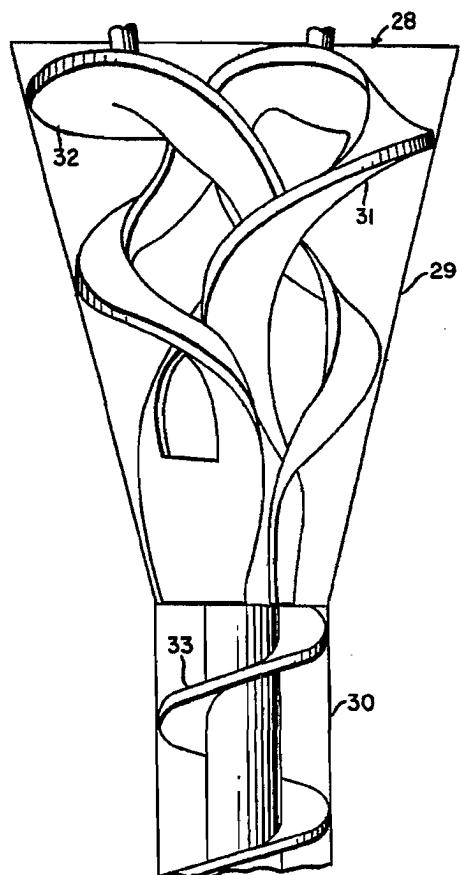


FIG. 2

Sept. 20, 1955

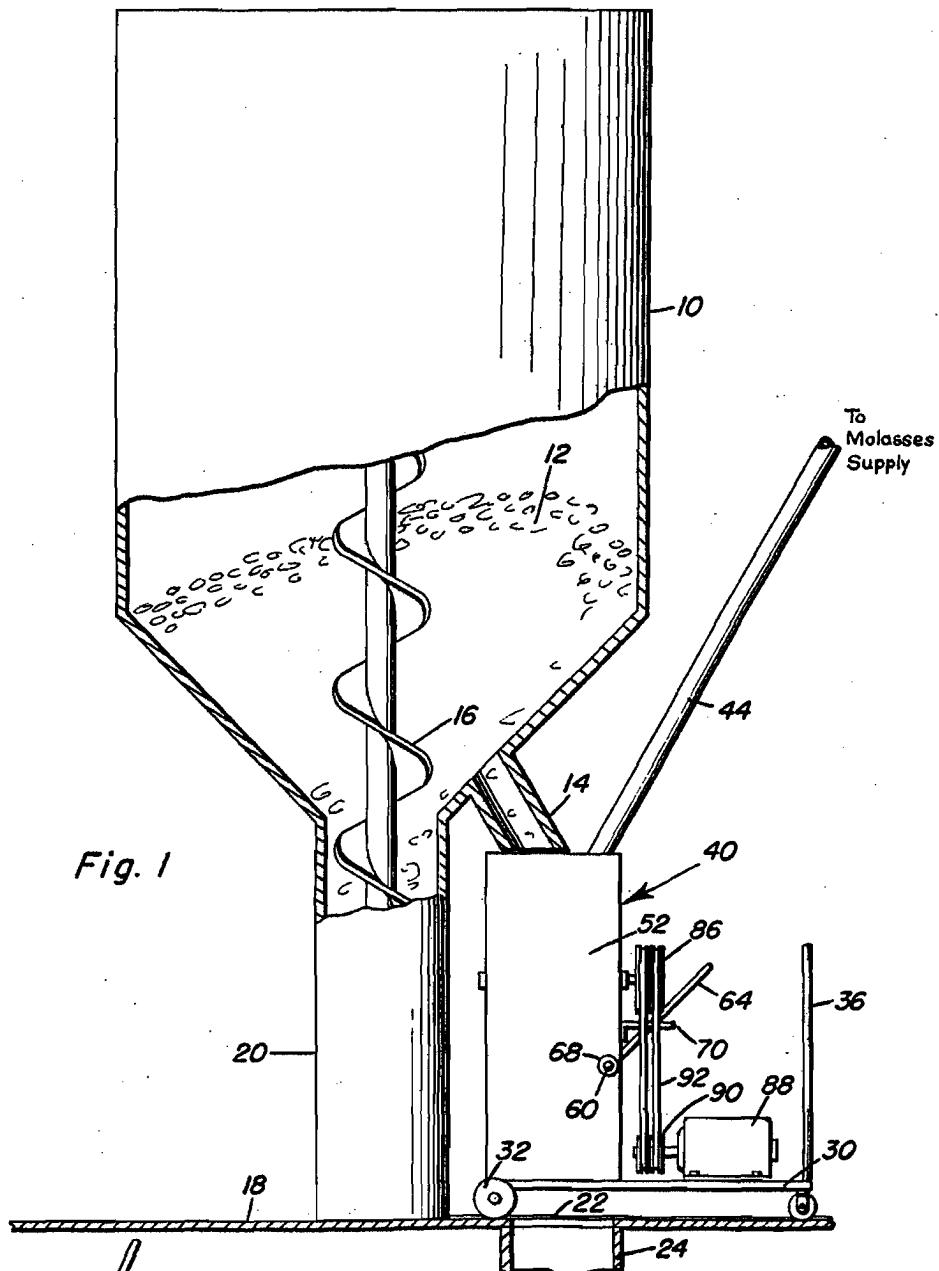
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2,718,384

MOLASSES BLENDER

Filed March 4, 1954

2 Sheets-Sheet 1



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2,718,384

MOLASSES BLENDER

Filed March 4, 1954

2 Sheets-Sheet 2

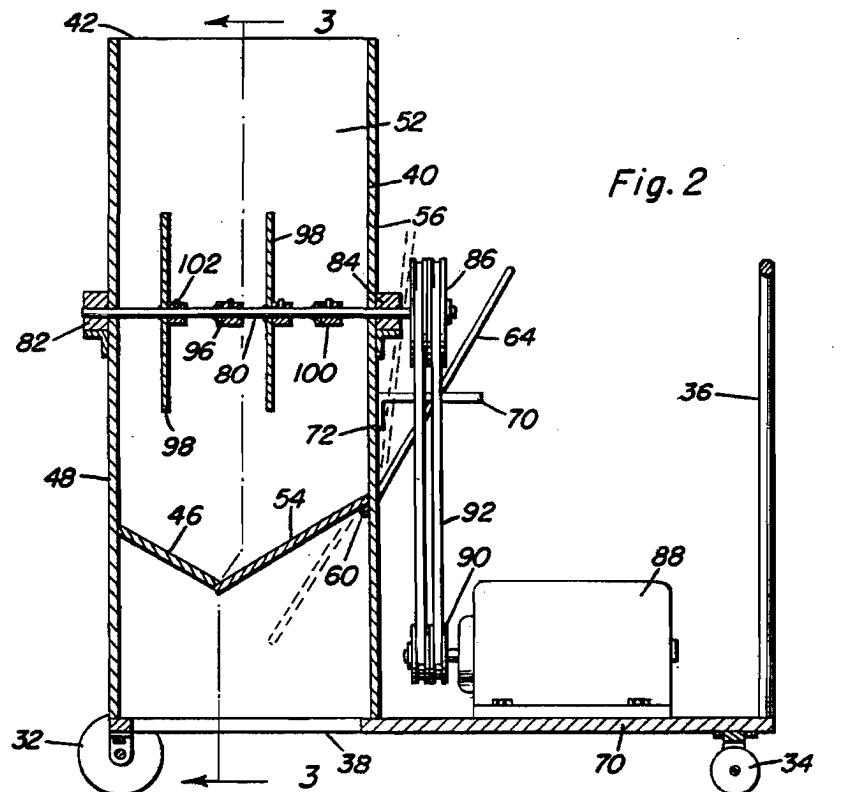


Fig. 2

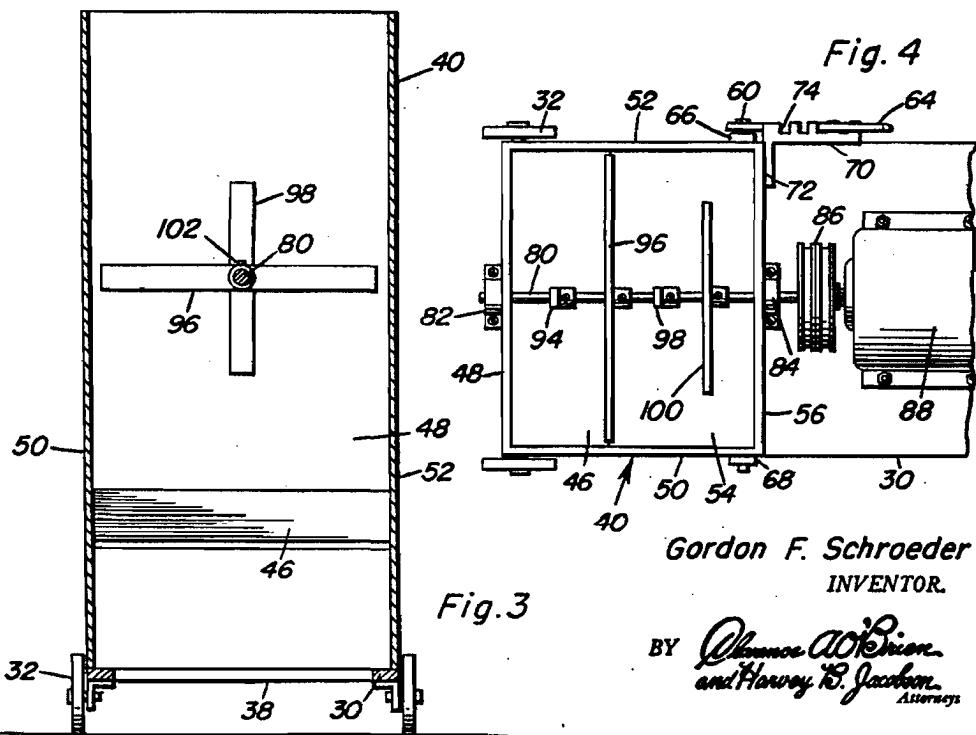


Fig. 3

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2,718,384

MOLASSES BLENDER

Gordon F. Schroeder, Menomonie, Wis.

Application March 4, 1954, Serial No. 414,179

2 Claims. (Cl. 259—9)

This invention relates to a molasses blender and particularly to a portable device for blending molasses with dry feed for feeding stock and other purposes.

In feeding dry grain feed to stock materially improved benefits may be obtained if molasses is blended with the dry grain not only in that it is more palatable to the stock but the benefits secured therefrom will be increased.

Because of the sticky nature of the molasses considerable difficulty has heretofore been experienced in uniformly blending the molasses with the dry feed such as ground grain or the like.

The present invention provides a blender which uniformly blends the molasses through the ground mixture so that there will be a substantial uniformity of the amount of molasses fed with the various portions of feed and so as to prevent balling up of the material because of drops of molasses therein.

In the construction according to the present invention the blender comprises a mixing chamber adapted to receive a stream of molasses together with a stream of dry feed from any suitable feeder either of vertical or inclined type with the material being poured in at a substantially uniform stream into the top of the mixing chamber where suitable blending blades or mixing blades will cause mingling of the two streams of material so that the molasses will be uniformly mixed with the dry feed material and a control gate is placed intermediate the ends of the chamber to control the rate of flow through the mixing chamber so that the mixing may be thoroughly accomplished.

It is accordingly an object of the invention to provide an improved molasses blender.

It is a further object of the invention to provide a blender having means for controlling the rate of flow therethrough.

It is a further object of the invention to provide an improved mixing blade for a molasses blender.

Other objects and many of the attendant advantages of the present invention will be apparent from the accompanying description taken in conjunction with the accompanying drawing in which:

Figure 1 is an elevational view partially in section of the molasses blender according to the invention;

Figure 2 is a vertical elevation through the molasses blender;

Figure 3 is a transverse vertical section through the molasses blender taken substantially on the plane indicated by the section line 3—3 of Figure 2;

Figure 4 is a top plan view of the molasses blender; and

Figure 5 is a perspective view of a portion of the control gates showing the construction thereof.

In the exemplary embodiment according to the invention a suitable container 10 is provided with a quantity of dry feed 12 and is also provided with an outlet aperture 14 through which the dry feed may be impelled by a suitable agitator 16. The entire device may be

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mounted in any manner but is shown as being mounted on the floor 18 by means of a suitable column 20 in which may be mounted suitable driving mechanism for the agitator 16. The feed delivered through the spout 14 will fall through an aperture 22 in the floor 18 and be delivered to a suitable chute 24 to be delivered to various feeding compartments or into any other suitable container.

The molasses blender itself comprises a suitable platform 30 having a pair of front wheels 32 and a swivel rear wheel 34. Preferably the platform 30 is provided with a handle 36 by which the platform may be moved about on the wheels 32 and 34.

The platform 30 is provided with an aperture 38 so that the feed from the mixing chamber presently to be described may be discharged through the aperture 22 into the chute 24.

The mixing chamber comprises an elongated vertically extended chamber preferably substantially rectangular in cross section with the chamber being mounted rigidly on the platform 30 so that material fed into the top 42 of the container 40 will be discharged through the aperture 38 as may be desired. As indicated in Figure 1 the blender will be moved about to any desired spout 14 so that the dry feed may be fed thereinto and a suitable conduit 44 will be employed to supply the molasses into the top of the container 40. The rate of flow of the material through the blender will be controlled by means of a control gate or closure placed intermediate the ends of the container 40 preferably constitute a baffle board 46 which is rigidly fixed in the container and have one side thereof connected to a side 48 of the container 40 and extends from end to end of the device such as the walls 50 and 52 of the device. A swinging gate or door 54 is mounted adjacent to the wall 56 opposite to the wall 48 by means of a control shaft 60. The control shaft 60 being journaled in the opposed walls 50 and 52 and the door 54 being swingable into and out of closing relation with the baffle 46. The control handle 64 is rigidly connected to the shaft 60 and being operable to cause swinging motion of the gate or door 54.

Preferably bearing hubs 66 and 68 are mounted on the sides 52 and 50 to receive the ends of the shaft 60 to prevent undue wear of the material of the chamber. In order to lock the gate 54 in a suitable selected position a rack bar 70 is secured to the side of the chamber 40 by means of an angle bar 72 with the rack bar 70 extending substantially perpendicular to the side of the container so that the lever 64 may be selectively connected in the slots 74 to locate the lever in any desired position. Preferably the lever 64 is of somewhat resilient material so that it may be readily sprung in or out of the slot 74.

In order to provide proper mixing or blending of the dry feed with the molasses, the mixer comprises a shaft 80 extending transversely of the chamber 40 intermediate the closure and the top 42 of the device. The ends of the shaft 80 are preferably mounted in suitable hubs 82 and 84 and will carry suitable driving devices such as the sheaves 86. The driving motor 88 will preferably be mounted on a platform 30 and having a sheave 90 connected to the sheave 86 by any suitable means such as the V-belts 92.

A plurality of mixing blades 94, 96, 98 and 100 will be mounted on the shaft 80 preferably in substantially evenly spaced relation therewith and will be rigidly secured thereto by any suitable means such as the set screws 102. Preferably the blades 94, 98 and 100 are of substantially identical length and are somewhat less length than the width of the chamber 40. However, the blade 96 is preferably longer than the blades 94, 98 and

100 and preferably is of sufficient length that it has a minimum clearance with the sides 50 and 52 of the container 40. Preferably the blade 96 will be positioned at about the region of the entrance of the material to be mixed so that it will be scattered about so as to be meted and blended by the blades 94, 98 and 100 as well as by the blade 96.

In the operation of the blender according to the invention, the platform 30 will be assembled with the chamber 40 in position to receive material from the spouts 14 and the conduit 44 and the gate 54 will be adjusted to control the amount of flow therethrough so that a predetermined amount of material will be in the chamber. The motor 88 will be geared to the shaft 80 so that the shaft 80 is rotated at approximately the speed of 800 R. P. M. and in the preferred embodiment of the device the distance between the walls 50 and 52 will be substantially 12 inches so that the length of the blade 96 will be on the order of 11 inches while the blades 94, 98 and 100 are of the length of the order of 8 inches. Obviously, this dimension will change for various sizes of devices but in general the proportions will be maintained so that the mixing will be very thorough so that the liquid molasses will be evenly distributed through the dry material.

For simplicity of illustration and description the preferred embodiment of the invention has been shown and described according to the best present understanding thereof. However, it will be apparent to those skilled in the art that various changes and modifications in the construction and arrangement of parts thereof may readily be resorted to without departing from the true spirit and scope of the invention.

What is claimed as new is as follows:

1. A portable molasses blender comprising a platform, supporting wheels on said platform elevating the same, a vertically extending mixing chamber having an open bottom seated on said platform, said platform having an aperture into which the bottom of said chamber

ber opens, a closure in said chamber above said bottom, said closure including a sloping baffle board fixed to the walls of said chamber, said baffle board extending into contact with one wall of said chamber, a door member pivotally mounted adjacent the opposed wall of said chamber, said door being swingable into and out of closing engagement with said baffle board, an operating lever fixed to said door, a toothed rack mounted on said chamber, said lever being engageable with said rack to selectively position said door with respect to said baffle board.

2. A portable molasses blender comprising a platform, supporting wheels on said platform elevating the same, a vertically extending mixing chamber having an open bottom seated on said platform, said platform having an aperture into which said bottom opens, a closure in said chamber above said bottom, said closure including a sloping baffle board fixed to the walls of said chamber, said baffle board extending into contact with one wall of said chamber, a door member pivotally mounted adjacent the opposed wall of said chamber, said door being swingable into and out of closing engagement with said baffle board, an operating lever fixed to said door, a toothed rack mounted on said chamber, said lever being engageable with said rack to selectively position said door with respect to said baffle board, a shaft extending transversely of said chamber intermediate said closure and the top of said chamber, a plurality of mixing blades fixed in spaced relation on said shaft, an intermediate one of said blades being longer than the remaining blades, said blade having minimum clearance with the sides of said chamber, and an inclined supply pipe extending into the top of said chamber.

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